

PRELIMINARY DATA SUMMARY

JUNE 1991

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

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CERC Field Research Facility
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Michael W. Leffler at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

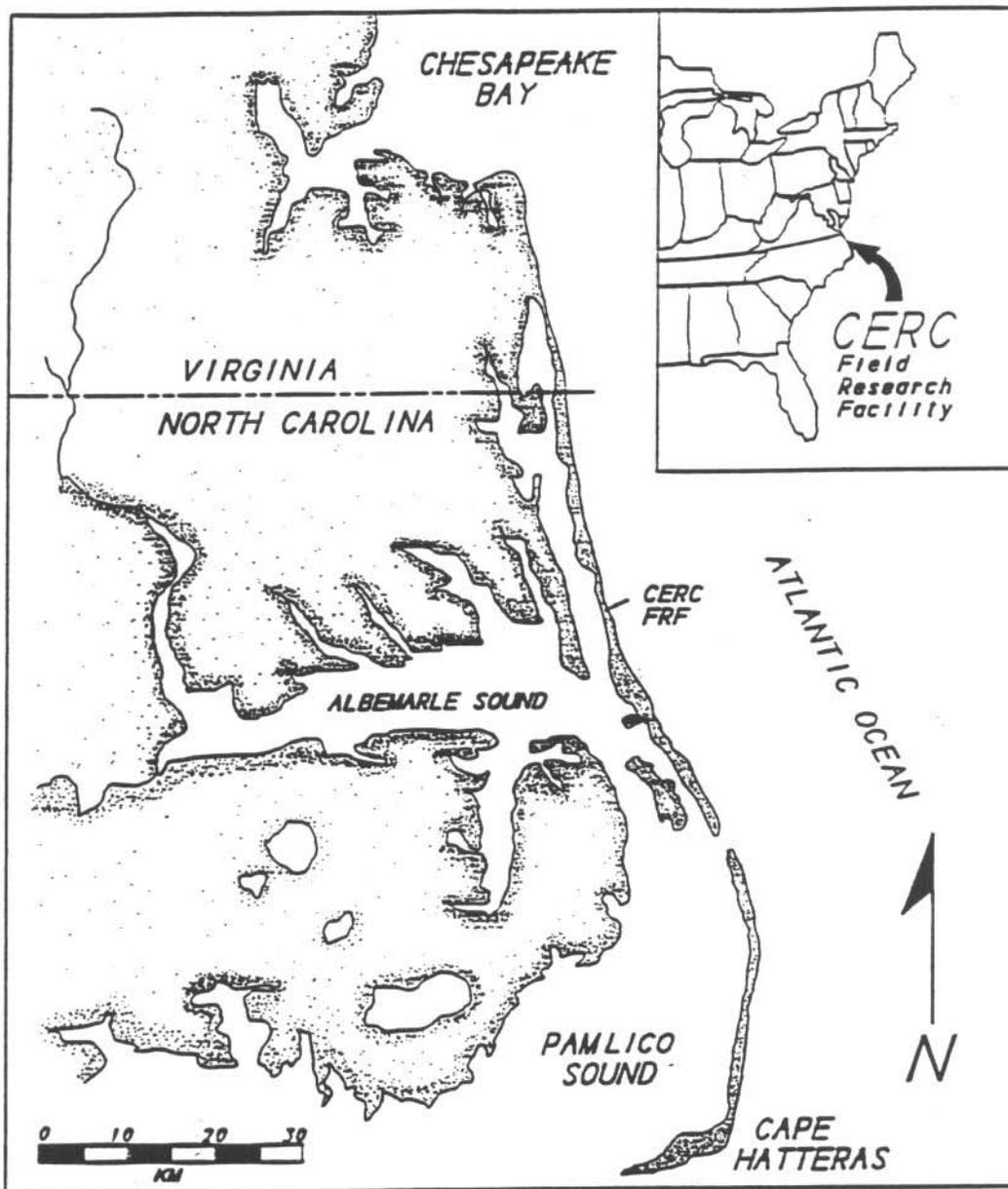


Figure 1. FRF Location Map

Table 1: Instrument Status/Data Availability

JUN 1991

Gage ID	Description/Remarks	Depth at Sensor		Day of the month																													
				1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	2	2	2	2	2	2	2	3
616	Barometric Pressure		Gage Status	*****																													
			Data Collected	***** / *****																													
			Analog Record	*****																													
604	Precipitation		Gage Status	*****																													
			Data Collected	***** / *****																													
624	Air Temperature		Gage Status	*****																													
			Data Collected	***** / *****																													
932	Anemometer at seaward end of pier Elevation 19 m (NGVD)		Gage Status	*****																													
			Data Collected	***** / *****																													
645	Baylor staff at station 7+80 on FRF pier	see Figure 7	Gage Status	*****																													
			Data Collected	***** / *****																													
625	Baylor staff at station 18+60 on FRF pier	see Figure 7	Gage Status	*****																													
			Data Collected	***** / *****																													
111	Pressure gage 309 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m NGVD	Gage Status	*****																													
			Data Collected	***** / *****																													
630	Waverider buoy 6.0 km offshore	Approx. 23 m NGVD	Gage Status	*****																													
			Data Collected	* / * * / * * / - / * / / * * *																													
519	Current meter 320 m north of FRF pier (0.9 km offshore)	see Figure 7	Gage Status	*****																													
			Data Collected	***** / *****																													
865-1370	NOAA tide station at seaward end of FRF pier		Gage Status	*****																													
			Data Collected	* / * * * * * / *																													
Supplemental Observations (daily oceanographic and meteorological observations)			Daily observation	*****																													

Gage Status Daily Observation Analog Record Data Collected
 Operational = * Complete = * Complete = * All = *
 Partial = / Partial = / Partial = / Partial = /
 Non-Operational = - None = - None = - None = -

True North



- Pier Building at 0+40 to 1+00
- Anemometer at 0+70
- 12 Inch Rain Gage at 0+30
- Instrument Shelter at 0+40

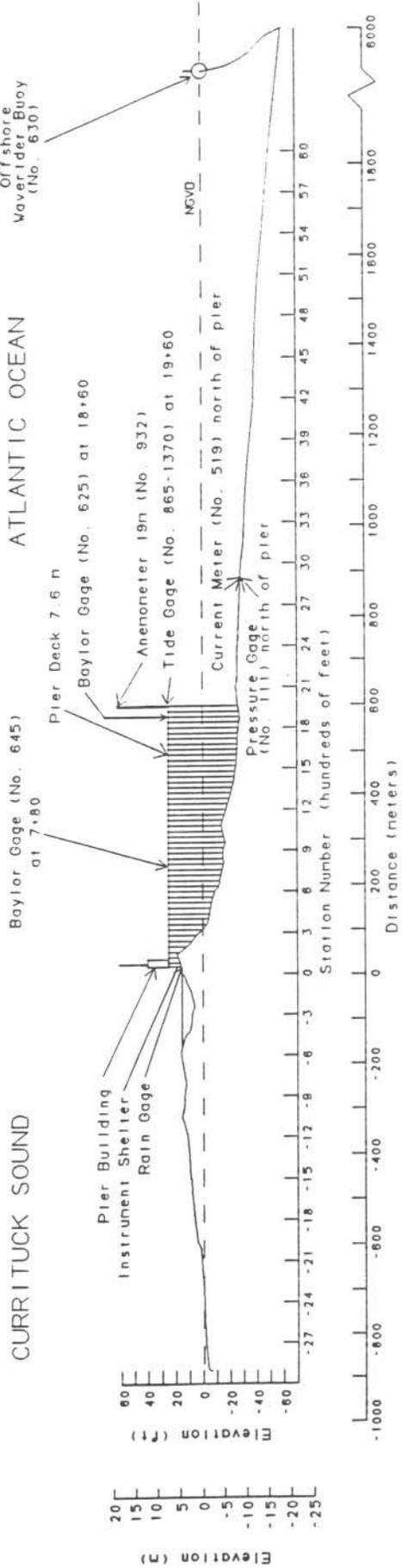
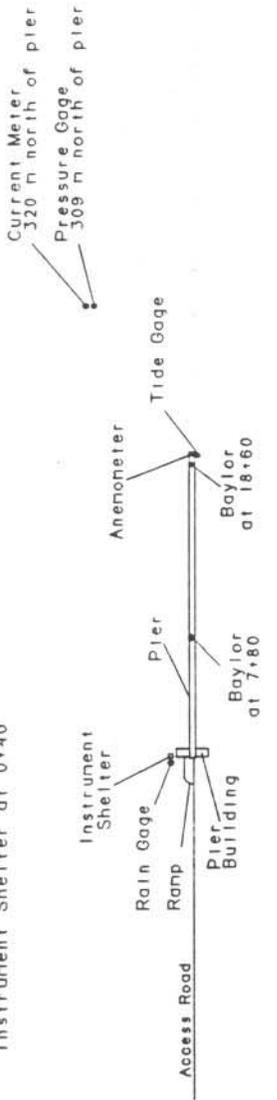


Figure 2. Instrument locations at FRF (all elevations from NGVD, all distances from FRF baseline).

PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $\text{mm} \times .03937 = \text{in.}$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $\text{mb} \times 0.02953 = \text{in. Hg}$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $\text{m/s} \times 1.943 = \text{kn}$

Table 2: Meteorological Data

Jun 1991

Day	Hour	Wind	Wind	Temperature	Atm	Precipitation
		Speed m/sec	Direction deg TN	deg C	Pressure mb	mm
1	100	5	256	29.3	1005.7	0
	700	6	333	29.3	1006.7	0
	1300	2	38	30.2	1007.0	0
	1900	4	124	27.8	1006.4	0
2	100	4	125	27.3	1006.0	0
	700	3	82	26.8	1006.7	21
	1300	4	32	28.3	1006.4	0
	1900	3	68	27.4	1005.4	0
3	100	4	359	27.4	1005.0	0
	700	4	34	26.9	1005.0	0
	1300	3	61	29.8	1005.0	0
	1900	2	111	27.9	1003.7	0
4	100	2	209	26.7	1002.3	0
	700	5	302	27.4	1002.0	0
	1300	15	355	27.6	1003.3	0
	1900	10	19	24.4	1006.7	0
5	100	8	24	23.4	1009.4	0
	700	10	41	22.5	1011.8	0
	1300	10	24	23.5	1014.8	0
	1900	9	45	22.0	1016.5	0
6	100	8	42	22.0	1017.5	0
	700	9	45	22.5	1019.2	0
	1300	10	52	22.7	1020.6	0
	1900	9	48	22.1	1020.9	0
7	100	9	43	21.9	1020.9	0
	700	10	26	22.4	1021.9	0
	1300	9	24	22.9	1021.9	0
	1900	7	27	22.3	1020.6	0
8	100	6	35	22.5	1018.9	0
	700	5	28	23.2	1019.2	0
	1300		Hardware Error			0
	1900	3	179	24.0	1017.5	0
9	100	4	225	23.8	1018.2	0
	700	5	269	25.3	1019.6	0
	1300	2	83	30.2	1019.9	0
	1900	4	189	27.0	1019.6	0
10	100	5	227	25.0	1019.9	0
	700	5	267	26.2	1020.6	0
	1300	4	233	31.3	1019.2	0
	1900	7	197	27.7	1017.9	0
11	100	8	238	25.4	1018.2	0
	700	8	238	25.6	1017.9	0
	1300	6	217	30.3	1016.2	0
	1900	9	199	27.4	1014.5	0
12	100	9	228	25.9	1014.2	0
	700	8	239	25.8	1014.2	0
	1300	7	236	29.6	1012.1	0
	1900	6	229	29.1	1010.4	0
13	100	6	241	26.7	1011.1	0
	700	8	340	24.8	1013.5	0
	1300	6	66	25.9	1014.8	0
	1900	5	107	24.2	1014.8	0
14	100	2	182	23.6	1016.5	0
	700	2	169	27.3	1017.2	0
	1300	5	149	29.0	1017.5	0
	1900	6	152	26.2	1016.5	0
15	100	8	198	27.2	1014.8	0
	700	7	229	27.5	1015.5	0
	1300	7	217	32.6	1013.5	0
	1900	10	204	29.4	1011.8	0
16	100	8	224	27.4	1011.4	0
	700	7	224	27.7	1011.4	0
	1300	7	203	33.5	1009.8	0
	1900	9	195	29.9	1008.1	0

* electronic problems

(Continued)

Table 2: Meteorological Data

Jun 1991

Day	Hour	Wind Speed	Wind Direction	Temperature	Atm Pressure	Precipitation
		m/sec	deg TN	deg C	mb	mm
17	100	5	223	27.3	1008.7	0
	700	3	219	28.4	1010.1	0
	1300	5	220	30.3	1010.8	0
	1900	7	207	29.5	1010.4	0
18	100	5	218	28.3	1011.8	0
	700	4	166	26.4	1012.5	0
	1300	6	206	27.8	1013.8	0
	1900	4	178	28.1	1013.1	0
19	100	7	196	28.3	1013.8	0
	700	1	117	26.4	1014.8	0
	1300	3	160	27.3	1015.5	5
	1900	4	26	27.5	1015.5	8
20	100	3	65	27.5	1015.2	0
	700	3	50	27.4	1015.9	0
	1300	5	68	26.6	1014.5	0
	1900	3	99	26.5	1013.5	0
21	100	2	100	26.9	1011.8	0
	700	3	27	26.7	1012.5	0
	1300	4	79	29.2	1011.8	0
	1900	5	127	27.1	1011.1	0
22	100	2	81	27.0	1010.4	0
	700	2	100	28.4	1010.1	0
	1300	6	132	31.1	1008.4	0
	1900	4	182	27.0	1006.4	21
23	100	5	233	26.3	1006.7	4
	700	5	306	26.5	1008.4	0
	1300	10	10	26.1	1009.8	0
	1900	14	20	25.0	1013.5	0
24	100	10	17	23.7	1016.5	0
	700	11	18	23.9	1018.6	0
	1300	10	27	24.2	1020.3	0
	1900	7	44	23.8	1019.9	0
25	100	5	59	23.8	1020.9	0
	700	8	34	24.4	1020.9	0
	1300	9	47	25.1	1021.3	0
	1900	6	53	24.8	1020.3	0
26	100	5	44	24.9	1020.3	0
	700	6	77	26.1	1020.3	0
	1300	5	55	28.1	1020.6	0
	1900	5	90	26.1	1019.9	0
27	100	3	68	25.3	1020.3	0
	700	5	43	26.3	1021.9	0
	1300	5	50	27.6	1021.9	0
	1900	4	49	26.1	1015.9	0
28	100	4	112	25.6	1019.2	0
	700	0		27.6	1019.2	0
	1300	4	115	30.0	1017.9	0
	1900	7	171	28.9	1015.9	0
29	100	6	224	27.9	1015.5	0
	700	6	234	27.8	1014.5	0
	1300	5	223	33.0	1012.8	0
	1900	6	196	31.1	1011.1	0
30	100	9	221	28.6	1011.4	0
	700	8	232	28.9	1010.4	0
	1300	6	225	34.7	1008.7	0
	1900	6	210	31.9	1007.4	0
		<u>Resultant</u>		<u>Mean</u>	<u>Mean</u>	<u>Total</u>
		0		26.8	1014.0	59

PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for four contiguous 34-min records.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all H_{mo} and T_p values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Jun 1991

Day	Hour	645		625		111		630	
		Baylor at 7+80		Baylor at 18+60		Pressure Gage		Offshir Wvrdr	
		Hmo.m	T.sec	Hmo.m	T.sec	Hmo.m	T.sec	Hmo.m	T.sec
1	0100	0.35	11.13	0.31	11.13	0.32	11.64	0.43	8.53
	0700	0.34	11.13	0.34	11.13	0.35	11.13	0.41	7.76
	1300	0.37	10.24	0.31	10.67	0.34	11.13	0.41	10.67
	1900	0.31	10.67	0.32	10.24	0.31	10.67	0.36	11.13
2	0100	0.32	10.67	0.33	10.67	0.32	10.24	0.38	10.24
	0700	0.49	10.24	0.42	9.48	0.39	11.64	0.54	10.24
	1300	0.47	10.67	0.46	10.67	0.47	12.19	*	
	1900	0.71	10.67	0.63	11.13	0.67	10.67	0.56	9.85
3	0100	0.67	12.19	0.70	11.64	0.78	12.19	0.62	12.80
	0700	0.76	11.64	0.65	11.64	0.67	12.19	0.59	11.64
	1300	0.60	11.64	0.64	11.64	0.62	11.13	0.65	11.13
	1900	0.60	10.24	0.57	10.24	0.61	9.85	0.60	9.85
4	0100	0.55	11.64	0.57	11.13	0.59	10.67	0.58	11.13
	0700	0.47	10.24	0.47	11.13	0.52	10.24	0.51	10.67
	1300	1.00	4.20	1.06	4.27	1.43	4.13	1.34	4.49
	1900	1.31	6.09	1.50	6.40	1.63	6.09	1.98	6.09
5	0100	1.21	6.92	1.14	7.11	1.26	7.11	1.53	7.53
	0700	1.25	6.56	1.28	6.40	1.40	6.24	1.44	7.11
	1300	1.29	7.31	1.45	8.26	1.57	7.76	*	
	1900	1.24	7.11	1.29	8.00	1.42	8.00	1.53	5.45
6	0100	1.24	9.14	1.21	9.48	1.27	8.53	1.43	8.83
	0700	1.25	11.13	1.75	10.67	1.70	11.13	1.68	10.24
	1300	1.40	11.13	1.62	10.67	1.71	11.64	1.87	11.64
	1900	1.32	11.64	1.53	10.67	1.65	12.19	1.60	6.09
7	0100	1.34	10.67	1.27	10.67	1.46	10.67	1.43	5.57
	0700	1.19	4.92	1.44	5.57	1.57	4.92	1.60	6.92
	1300	1.32	5.02	1.38	5.82	1.46	5.95	1.58	6.56
	1900	1.28	8.83	1.25	8.83	1.41	8.53	1.42	8.00
8	0100	1.30	7.31	1.20	9.85	1.33	7.76	1.39	7.11
	0700	1.11	9.85	1.12	7.76	1.13	7.76	1.26	6.74
	1300				Hardware Error				
	1900	0.88	9.14	0.81	9.48	0.90	9.48	*	
9	0100	0.84	8.00	0.77	8.26	0.83	8.26	*	
	0700	0.50	7.53	0.60	8.26	0.66	9.85	*	
	1300	0.59	7.76	0.51	9.14	0.61	8.83	*	
	1900	0.48	9.48	0.47	8.83	0.50	9.14	*	
10	0100	0.41	8.83	0.44	8.83	0.58	8.53	*	
	0700	0.50	9.14	0.43	8.83	0.47	8.53	*	
	1300	0.49	10.24	0.42	8.26	0.50	8.83	0.56	9.14
	1900	0.41	9.14	0.41	10.24	0.52	9.14	0.56	9.14
11	0100	0.46	8.83	0.47	9.85	0.50	9.48	0.56	9.48
	0700	0.41	9.48	0.36	9.85	0.40	9.48	0.51	9.48
	1300	0.44	9.85	0.37	9.48	0.42	9.85	0.47	9.14
	1900	0.39	9.85	0.42	9.48	0.42	9.48	0.63	9.14
12	0100	0.38	8.53	0.34	9.85	0.35	9.85	0.54	9.14
	0700	0.40	9.48	0.36	9.48	0.37	9.48	0.46	9.14
	1300	0.33	9.14	0.32	9.48	0.35	9.48	0.44	9.48
	1900	0.36	9.48	0.40	9.85	0.41	9.48	0.58	9.48
13	0100	0.32	9.14	0.34	9.14	0.35	9.48	0.50	8.83
	0700	0.28	9.85	0.30	8.83	0.32	9.48	0.47	9.14
	1300	0.53	9.48	0.47	9.14	0.41	3.33	0.53	9.14
	1900	0.64	5.33	0.65	5.57	0.62	5.45	0.81	5.45
14	0100	0.69	6.40	0.66	6.09	0.72	7.11	0.79	5.95
	0700	0.62	5.57	0.61	5.95	0.62	5.82	0.73	5.82
	1300	0.49	10.67	0.44	9.14	0.44	9.14	0.46	9.85
	1900	0.37	9.14	0.41	8.53	0.38	9.14	0.48	8.83
15	0100	0.34	8.83	0.41	8.83	0.40	9.48	0.53	9.14
	0700	0.36	8.83	0.41	8.83	0.40	8.83	0.52	8.53
	1300	0.30	9.48	0.36	9.14	0.39	9.48	0.46	9.14
	1900	0.38	9.14	0.44	8.53	0.42	8.83	0.70	4.41
16	0100	0.34	8.83	0.35	8.53	0.38	8.53	0.52	8.83
	0700	0.40	8.83	0.40	9.14	0.46	8.53	0.62	5.02
	1300	0.37	8.26	0.44	8.83	0.45	8.53	0.57	8.00
	1900	0.44	8.83	0.45	9.14	0.51	8.00	0.68	8.26

* Electronic problems

(Continued)

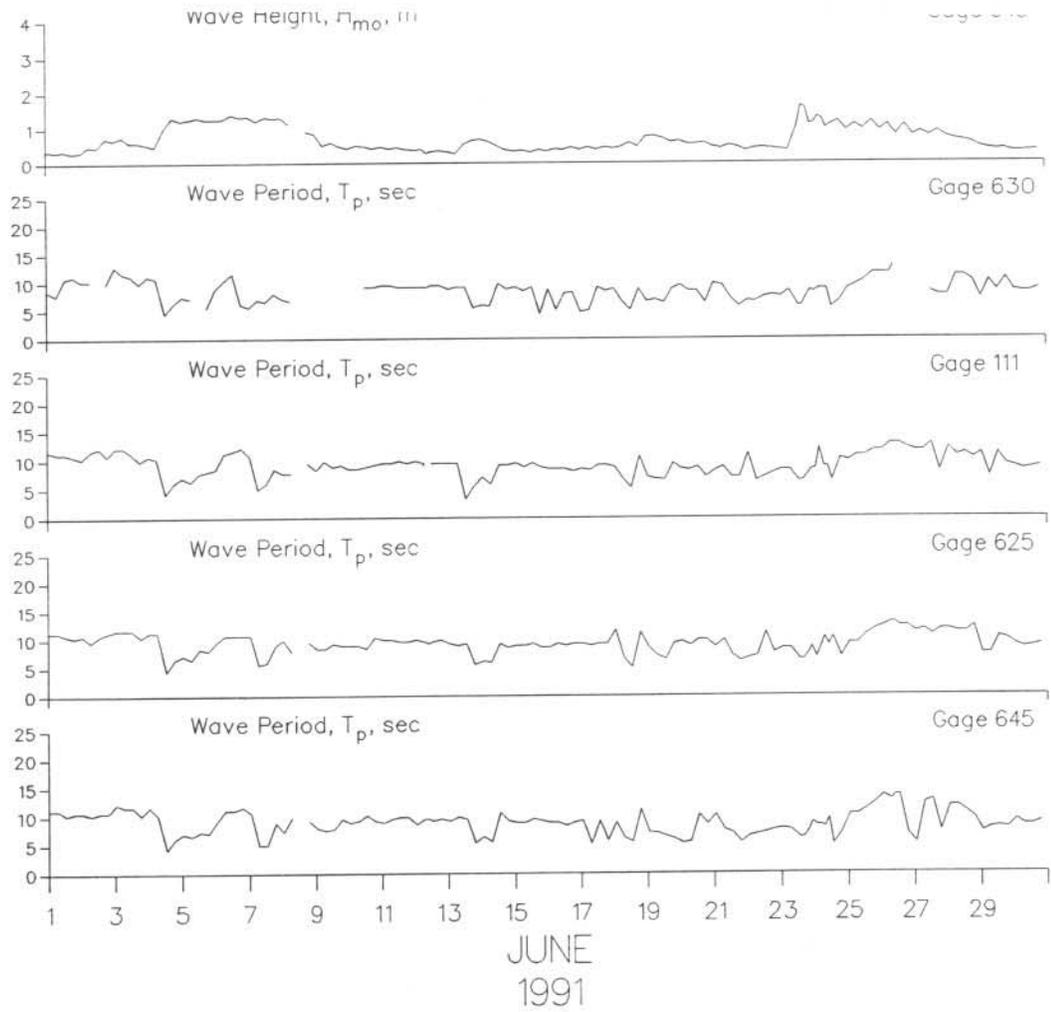
Table 3: Wave Data

Jun 1991

Day	Hour	645		625		111		630	
		Baylor at 7+80		Baylor at 18+60		Pressure Gage		Offshr Wvrdr	
		Hmo.m	T.sec	Hmo.m	T.sec	Hmo.m	T.sec	Hmo.m	T.sec
17	0100	0.38	9.14	0.44	9.14	0.44	8.53	0.68	4.74
	0700	0.44	5.12	0.47	8.83	0.48	8.26	0.57	5.02
	1300	0.38	9.14	0.42	9.14	0.42	9.14	0.55	9.14
	1900	0.44	5.69	0.47	9.14	0.47	9.14	0.56	8.53
18	0100	0.41	8.83	0.44	11.64	0.48	8.83	0.65	8.83
	0700	0.44	6.24	0.47	6.56	0.52	6.74	0.60	6.56
	1300	0.57	5.45	0.60	4.92	0.61	5.12	0.85	5.02
	1900	0.47	11.13	0.52	11.13	0.53	10.67	0.68	8.83
19	0100	0.75	7.11	0.72	8.53	0.71	7.11	0.81	6.56
	0700	0.77	6.92	0.75	7.11	0.76	6.74	0.85	6.92
	1300	0.70	6.40	0.70	6.40	0.70	6.56	0.79	6.40
	1900	0.59	5.95	0.58	9.14	0.64	9.48	0.73	8.83
20	0100	0.62	5.22	0.64	9.48	0.60	8.53	0.72	9.48
	0700	0.54	5.45	0.57	8.83	0.56	8.26	0.60	8.53
	1300	0.53	10.24	0.57	9.85	0.58	8.83	0.71	8.53
	1900	0.57	8.53	0.62	9.85	0.59	7.11	0.67	6.40
21	0100	0.47	10.24	0.53	8.53	0.53	8.00	0.61	9.85
	0700	0.41	7.53	0.49	9.85	0.47	8.83	0.52	9.48
	1300	0.49	6.92	0.55	7.11	0.59	7.11	0.63	7.11
	1900	0.44	5.33	0.47	6.09	0.46	7.11	0.49	5.69
22	0100	0.34	6.40	0.36	6.56	0.39	11.13	0.50	6.74
	0700	0.41	6.74	0.41	6.92	0.47	6.40	0.56	6.56
	1300	0.43	7.11	0.46	11.13	0.47	7.11	0.52	7.31
	1900	0.41	7.53	0.45	7.53	0.50	7.76	0.70	7.76
23	0100	0.38	7.76	0.42	8.26	0.50	8.26	0.62	7.53
	0700	0.36	7.53	0.42	8.26	0.39	8.26	0.56	8.53
	1300	1.08	6.09	0.97	6.24	1.03	6.24	1.18	5.82
	1900	1.56	7.31	2.19	7.31	2.43	7.31	2.71	7.53
24	0100	1.12	8.26	1.82	6.56	2.10	8.53	2.26	8.26
	0700	1.25	8.00	1.85	10.24	2.00	8.83	2.02	8.83
	1300	1.08	5.02	1.76	10.24	2.05	6.40	1.97	5.45
	1900	1.17	6.92	1.37	6.74	1.44	10.24	1.54	6.56
25	0100	0.91	10.24	1.27	9.14	1.26	9.85	1.36	8.83
	0700	1.08	10.24	1.31	9.14	1.33	10.67	1.39	9.48
	1300	0.95	11.13	1.52	10.67	1.43	10.67	1.55	10.24
	1900	1.18	12.19	1.38	11.64	1.48	11.64	1.59	11.64
26	0100	0.90	13.47	1.24	12.19	1.28	11.64	1.24	11.64
	0700	1.10	12.80	1.30	12.80	1.36	12.80	1.25	11.64
	1300	0.79	13.47	1.10	12.19	1.16	12.80		*
	1900	1.07	6.74	1.18	12.19	1.24	12.19		*
27	0100	0.76	5.22	1.01	11.13	1.11	11.64		*
	0700	0.88	12.19	1.06	11.64	1.04	11.64		*
	1300	0.75	12.80	1.02	10.67	1.07	12.80	1.25	8.26
	1900	0.88	7.31	0.98	11.64	1.04	8.00	1.24	7.76
28	0100	0.74	11.64	0.82	11.64	0.95	12.19	1.10	7.76
	0700	0.66	11.64	0.82	11.13	0.80	10.67	0.99	11.13
	1300	0.63	10.67	0.76	11.13	0.78	11.13	0.92	11.13
	1900	0.57	9.48	0.66	12.19	0.74	10.24	0.82	10.24
29	0100	0.45	7.11	0.53	7.31	0.56	11.13	0.67	7.11
	0700	0.40	7.76	0.49	7.31	0.51	7.11	0.55	10.24
	1300	0.36	8.00	0.44	10.24	0.44	11.13	0.49	8.53
	1900	0.38	7.76	0.46	9.85	0.47	9.14	0.58	10.67
30	0100	0.31	9.14	0.36	8.83	0.37	8.83	0.55	8.53
	0700	0.30	8.26	0.33	8.26	0.35	8.26	0.51	8.26
	1300	0.32	8.26	0.37	8.53	0.37	8.53	0.47	8.26
	1900	0.34	8.83	0.38	8.83	0.40	8.83	0.58	8.83
	Mean	0.66	8.73	0.74	9.17	0.78	9.08	0.87	8.38
	Std dev	0.34	2.09	0.43	1.79	0.47	1.93	0.48	1.86

* Electronic problems

(Sheet 2 of 2)



PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data
Jun 1991

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)		Dye 12m offshore (surface)			Speed	Dir
			Speed	Dir	Distance from Baseline (m)	Speed	Dir	Location	Speed		
1	0100	Along Cross Result								1 2 2	N on 277
1	0700	Along Cross Result	16 2 16	S on 169	165	14 1 14	S on 163	North	8 S	2 4 4	S on 223
1	1300	Along Cross Result								2 2 3	N off 25
1	1900	Along Cross Result								1 6 6	N on 259
2	0100	Along Cross Result								1 1 1	S on 205
2	0700	Along Cross Result	102 0 102	S 160	165	10 1 10	S on 163	North	13 S	5 0 5	S 160
2	1300	Along Cross Result								2 6 6	S off 88
2	1900	Along Cross Result								1 3 3	S on 232
3	0100	Along Cross Result								6 11 13	S off 99
3	0700	Along Cross Result	47 0 47	S 160	177	15 0 15	S 160	North	0	8 4 9	S off 133
3	1300	Along Cross Result								4 1 4	S off 146
3	1900	Along Cross Result								0 6 6	S on 250
4	0100	Along Cross Result								1 7 7	N on 258
4	0700	Along Cross Result	32 2 32	S off 157	165	14 1 14	S off 154	North	3 S	0 5 5	S on 250
4	1300	Along Cross Result								11 21 24	S off 98
4	1900	Along Cross Result								10 12 16	S off 110
5	0100	Along Cross Result								9 6 11	S off 126
5	0700	Along Cross Result	36 4 36	S on 166	201	68 7 68	S on 166	North	51 S	4 6 7	S off 104
5	1300	Along Cross Result								11 5 12	S on 184
5	1900	Along Cross Result								9 6 11	S off 126

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
Jun 1991

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir
6	0100	Along Cross Result									3 3 4	S off 115
6	0700	Along Cross Result	12 0 12	S 160	201	20 3 21	S on 169	North	11	N	4 4 6	S off 115
6	1300	Along Cross Result									3 4 5	S off 107
6	1900	Along Cross Result									0 0 0	
7	0100	Along Cross Result									1 7 7	N on 258
7	0700	Along Cross Result	29 0 29	S 160	189	76 0 76	S 160	North	10	S	3 1 3	S off 142
7	1300	Along Cross Result									1 4 4	S on 236
7	1900	Along Cross Result									1 5 5	N on 261
8	0100	Along Cross Result									1 6 6	S on 241
8	0700	Along Cross Result	34 0 34	S 160	177	23 11 25	N off 7	South	10	N	1 7 7	N on 258
8	1300	Along Cross Result										
8	1900	Along Cross Result									1 22 22	S on 247
9	0100	Along Cross Result									3 26 26	N on 257
9	0700	Along Cross Result	0 19 19	 on 250	177	32 0 32	N 340	South	10	N	2 8 8	N on 264
9	1300	Along Cross Result									2 9 9	N on 263
9	1900	Along Cross Result									2 9 9	N on 263
10	0100	Along Cross Result									2 9 9	N on 263
10	0700	Along Cross Result	0 8 8	 off 70	177	0 4 4	 off 70	South	9	N	1 5 5	N on 261
10	1300	Along Cross Result									3 9 9	N on 268
10	1900	Along Cross Result									0 8 8	 on 250

KEY = All speeds in cm/sec
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

Table 4: Current Data (Continued)
Jun 1991

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir
11	0100	Along Cross Result									3 11 11	N on 265
11	0700	Along Cross Result	8 16 18	N off 43	165	8 5 10	N off 11	South	8	N	0 9 9	N on 250
11	1300	Along Cross Result									13 7 15	N on 312
11	1900	Along Cross Result									8 3 9	N on 319
12	0100	Along Cross Result									11 10 15	N on 298
12	0700	Along Cross Result	6 12 13	N off 43	165	0 6 6	off 70	South	13	N	7 8 11	N on 291
12	1300	Along Cross Result									7 6 9	N on 299
12	1900	Along Cross Result									10 5 11	N on 313
13	0100	Along Cross Result									2 4 4	N on 277
13	0700	Along Cross Result	14 5 15	S on 179	165	38 0 38	S off 160	North	14	S	3 2 4	S off 126
13	1300	Along Cross Result									10 13 16	N off 32
13	1900	Along Cross Result									1 8 8	N on 257
14	0100	Along Cross Result									8 8 11	S off 115
14	0700	Along Cross Result	27 13 30	S on 187	140	3 1 3	S off 133	North	3	N	22 6 23	S off 145
14	1300	Along Cross Result									8 10 13	S off 109
14	1900	Along Cross Result									6 1 6	S off 151
15	0100	Along Cross Result									8 1 8	S off 153
15	0700	Along Cross Result	0 20 20	off 70	140	20 10 23	N off 7	South	13	N	2 5 5	N on 272
15	1300	Along Cross Result									4 1 4	S off 146
15	1900	Along Cross Result									4 6 7	N on 284

KEY = All speeds in cm/sec
N = Northward, Shore parallel
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on = onshore off = offshore

Table 4: Current Data (Continued)
Jun 1991

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Location	Speed	Dir	Speed	Dir
16	0100	Along Cross Result									2 5 5	N on 272
16	0700	Along Cross Result	12 6 14	N off 7	140	20 13 24	N off 13	South	20	N	8 8 11	N on 295
16	1300	Along Cross Result									2 2 3	N on 295
16	1900	Along Cross Result									16 8 18	N on 313
17	0100	Along Cross Result									6 5 8	N on 300
17	0700	Along Cross Result	5 6 8	N off 31	165	10 7 12	N off 17	South	4	N	3 3 4	N on 295
17	1300	Along Cross Result									3 7 8	S off 93
17	1900	Along Cross Result									8 4 9	N on 313
18	0100	Along Cross Result									1 1 1	S on 205
18	0700	Along Cross Result	12 0 12	N 340	177	27 8 28	N off 357	South	12	N	4 1 4	S off 146
18	1300	Along Cross Result									15 9 17	S off 129
18	1900	Along Cross Result									13 7 15	S off 132
19	0100	Along Cross Result									17 7 18	S off 138
19	0700	Along Cross Result	29 12 31	S on 182	177	20 3 20	S off 151	North	7	N	22 8 23	S off 140
19	1300	Along Cross Result									23 3 23	S off 153
19	1900	Along Cross Result									15 6 16	S off 138
20	0100	Along Cross Result									13 2 13	S off 151
20	0700	Along Cross Result	68 0 68	S 160	177	0 4 4	S off 70	North	17	N	30 7 31	S off 147
20	1300	Along Cross Result									21 9 23	S off 137
20	1900	Along Cross Result									12 5 13	S off 137

KEY = All speeds in cm/sec
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

Table 4: Current Data (Continued)
Jun 1991

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir
21	0100	Along Cross Result									1 1 1	N on 295
21	0700	Along Cross Result	25 3 26	S on 166	177	0 0 0		South	18	S	9 5 10	S off 131
21	1300	Along Cross Result									1 1 1	N on 295
21	1900	Along Cross Result									3 0 3	N 340
22	0100	Along Cross Result									11 7 13	N on 308
22	0700	Along Cross Result	38 6 39	N on 331	177	21 3 21	N on 331	South	10	N	4 1 4	S off 146
22	1300	Along Cross Result									4 6 7	N on 284
22	1900	Along Cross Result									0 3 3	 on 250
23	0100	Along Cross Result									1 0 1	S 160
23	0700	Along Cross Result	51 0 51	S 160	177	36 0 36	S 160	North	25	S	16 11 19	S off 125
23	1300	Along Cross Result									30 16 34	S off 132
23	1900	Along Cross Result									50 20 54	S off 138
24	0100	Along Cross Result									39 15 42	S off 139
24	0700	Along Cross Result	68 7 68	S on 166	189	102 0 102	S 160	North	38	S	37 18 41	S off 134
24	1300	Along Cross Result									19 9 21	S off 135
24	1900	Along Cross Result									14 6 15	S off 137
25	0100	Along Cross Result									14 6 15	S off 137
25	0700	Along Cross Result	15 0 15	S 160	189	14 14 20	N off 25	South	19	S	20 5 21	S off 146
25	1300	Along Cross Result									16 3 16	S off 149
25	1900	Along Cross Result									6 7 9	S off 111

KEY = All speeds in cm/sec
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

Table 4: Current Data (Concluded)
Jun 1991

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519		
		Alongshore Cross-shore Resultant	Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Speed
26	0100	-Along Cross Result								2	S
										4	off
										4	97
26	0700	-Along Cross Result	17	S	189	32	N	7	S	5	S
			0			3	off	South		2	off
			17	160		32	346			5	138
26	1300	-Along Cross Result								2	S
										0	
										2	160
26	1900	-Along Cross Result								11	N
										1	on
										11	335
27	0100	-Along Cross Result								6	N
										4	on
										7	306
27	0700	-Along Cross Result	0		177	24	N	18	N	7	N
			0			6	off	South		2	on
			0	0		25	354			7	324
27	1300	-Along Cross Result								1	S
										5	off
										5	81
27	1900	-Along Cross Result								11	N
										0	
										11	340
28	0100	-Along Cross Result								13	N
										2	on
										13	331
28	0700	-Along Cross Result	10	N	177	12	N	10	N	13	N
			0			3	off	South		5	on
			10	340		12	357			14	319
28	1300	-Along Cross Result								9	N
										2	on
										9	327
28	1900	-Along Cross Result								18	N
										9	on
										20	313
29	0100	-Along Cross Result								14	N
										8	on
										16	310
29	0700	-Along Cross Result	20	N	165	0		8	N	9	N
			12	off		10	off	South		7	on
			24	11		10	70			11	302
29	1300	-Along Cross Result								2	N
										1	on
										2	313
29	1900	-Along Cross Result								23	N
										5	on
										24	328
30	0100	-Along Cross Result								6	N
										4	on
										7	306
30	0700	-Along Cross Result	0		165	0		3	N	2	N
			8	off		6	off	South		6	on
			8	70		6	70			6	268
30	1300	-Along Cross Result								1	S
										1	off
										1	115
30	1900	-Along Cross Result								18	N
										0	
										18	340

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 S = Southward, Shore parallel
 on = onshore off = offshore

PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Jun 1991

Day	Time	Wave Approach Angle at Pier End deg from True N		Radar Wave Angle deg from True N	Width of Surf Zone.m	Water Characteristics at Pier End		
		Primary	Secondary			Temp.,C	Density g/cc	Secchi Vis.,m
1	0846	100	30		9	20.6	1.0226	4.6
2	1030	105			15	25.6	1.0180	2.4
3	0800	75		65	13	25.6	1.0171	3.4
4	0742	75	30		6	25.6	1.0184	4.6
5	0754	50	30	50	163	24.4	1.0186	0.9
6	0740	60	15	70	180	22.8	1.0180	0.6
7	0800	60	5	65	185	22.2	1.0178	0.6
8	0818	80	10	65	158	21.7	1.0182	0.6
9	0845	100			15	22.8	1.0196	1.8
10	0807	100			8	21.7	1.0210	1.5
11	0730	90			5	20.0	1.0222	1.2
12	0813	130			6	17.8	1.0234	1.8
13	0748	90	30	45	5	18.3	1.0234	3.4
14	0804	40	100		30	22.8	1.0195	3.7
15	0910	120			9	20.6	1.0218	3.0
16	0940	105			14	17.2	1.0230	2.1
17	0842	130			9	17.8	1.0230	2.7
18	0731	100	125		15	17.8	1.0234	2.7
19	0841	55	115		18	22.2	1.0210	4.3
20	0711	100	45	60	6	23.9	1.0192	3.7
21	0814	105			11	24.4	1.0184	5.8
22	0930	100			7	25.6	1.0182	2.7
23	1021	45	0	45	15	25.0	1.0198	4.6
24	0730	60	25	65	207	22.8	1.0192	0.6
25	0742	90	40	80	193	22.2	1.0196	0.6
26	0808	80	45	80	165	22.8	1.0196	0.6
27	0800	95		95	194	23.3	1.0198	1.5
28	0810	80	110		162	24.4	1.0198	3.4
29	0730	100			12	22.8	1.0214	1.2
30	1130	100			5	21.1	1.0218	2.7

PART VI: WATER LEVELS

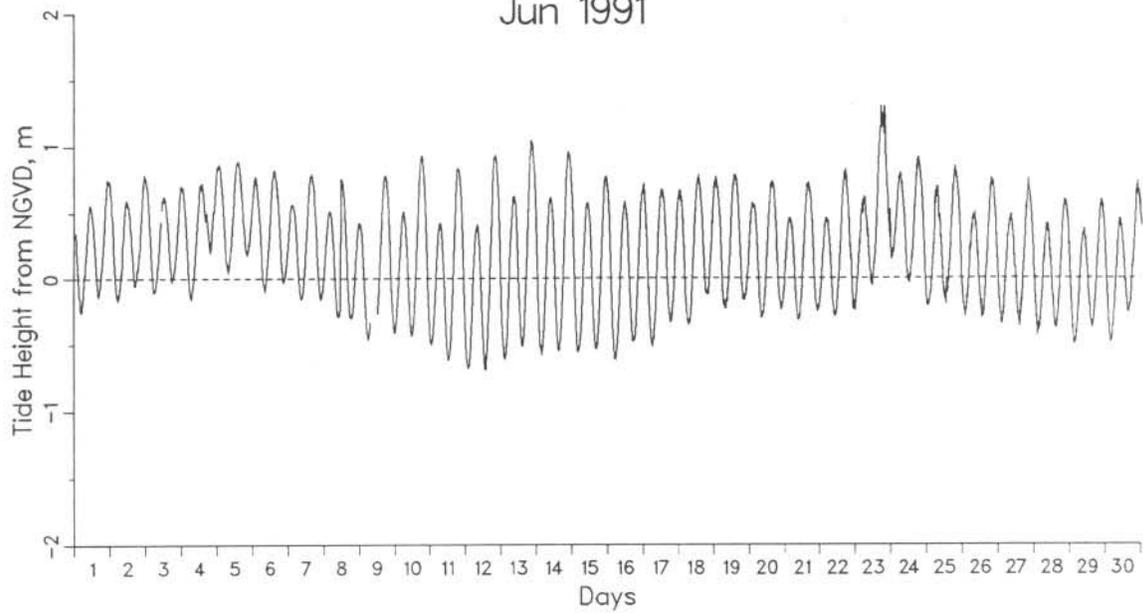
Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

FRF Tide Heights

Jun 1991



Monthly Water Levels, m NGVD

Extreme Low = -0.69 on day 12 at 1230 EST
Extreme High = 1.30 on day 23 at 1842 EST
Monthly Mean = 0.20
Mean Low = -0.30
Mean High = 0.71
Mean Range = 1.01

Table 6: Water Levels,m NGVD

		Jun 1991			
Mid-Cycle	Low	High	Mean	Range	
Day	Time				
1	548	-0.26	0.57	0.17	0.82
1	1813	-0.14	0.75	0.31	0.89
2	638	-0.16	0.59	0.22	0.76
2	1903	-0.05	0.79	0.36	0.84
3	728	-0.10	0.62	0.26	0.72
3	1954	-0.02	0.70	0.34	0.73
4	819	-0.16	0.73	0.29	0.89
4	2044	0.20	0.87	0.55	0.68
5	909	0.04	0.89	0.48	0.85
5	2134	0.17	0.77	0.47	0.60
6	1000	-0.10	0.83	0.37	0.93
6	2225	-0.03	0.57	0.29	0.60
7	1050	-0.16	0.80	0.31	0.95
7	2315	-0.16	0.52	0.20	0.68
8	1140	-0.30	0.76	0.07	1.05
9	6	-0.46	0.42	0.00	0.88
9	1231				
10	56	-0.41	0.51	0.07	0.92
10	1321	-0.43	0.93	0.24	1.36
11	146	-0.50	0.49	0.00	0.99
11	1412	-0.62	0.84	0.10	1.45
12	237	-0.68	0.41	-0.11	1.09
12	1502	-0.69	0.94	0.12	1.63
13	327	-0.61	0.62	0.04	1.23
13	1552	-0.51	1.05	0.25	1.56
14	418	-0.58	0.61	0.06	1.19
14	1643	-0.55	0.96	0.20	1.51
15	508	-0.56	0.58	0.04	1.14
15	1733	-0.54	0.77	0.11	1.31
16	558	-0.62	0.58	0.00	1.20
16	1823	-0.48	0.72	0.10	1.19
17	649	-0.52	0.68	0.09	1.19
17	1914	-0.33	0.67	0.18	1.00
18	739	-0.36	0.78	0.18	1.14
18	2004	-0.12	0.77	0.33	0.89
19	829	-0.23	0.79	0.27	1.01
19	2055	-0.16	0.64	0.23	0.80
20	920	-0.30	0.74	0.20	1.04
20	2145	-0.23	0.60	0.16	0.84
21	1010	-0.32	0.73	0.17	1.04
21	2235	-0.25	0.62	0.15	0.87
22	1101	-0.29	0.83	0.22	1.12
22	2326	-0.24	0.65	0.23	0.89
23	1151	-0.05	1.30	0.52	1.35
24	16	0.14	1.30	0.57	1.16
24	1241	-0.03	0.92	0.42	0.95
25	107	-0.21	0.72	0.24	0.93
25	1332	-0.20	0.85	0.30	1.05
26	157	-0.29	0.67	0.16	0.95
26	1422	-0.30	0.76	0.21	1.05
27	247	-0.34	0.55	0.12	0.89
27	1513	-0.37	0.76	0.18	1.12
28	338	-0.43	0.43	0.03	0.87
28	1603	-0.37	0.60	0.11	0.97
29	428	-0.50	0.38	-0.04	0.88
29	1653	-0.37	0.60	0.10	0.97
30	519	-0.48	0.46	-0.01	0.94
30	1744	-0.26	0.74	0.20	0.99

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Geodimeter surveying system; a Geodimeter 140-T self-tracking, electronic theodolite, distance meter, in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in May and the two surveys in June on profile line 188, located 517 m south of the pier. The most significant change was the formation of a nearshore bar and trough (150 - 280 m) from what was previously a featureless nearshore plateau. Only minor changes are visible on the remainder of the profile.

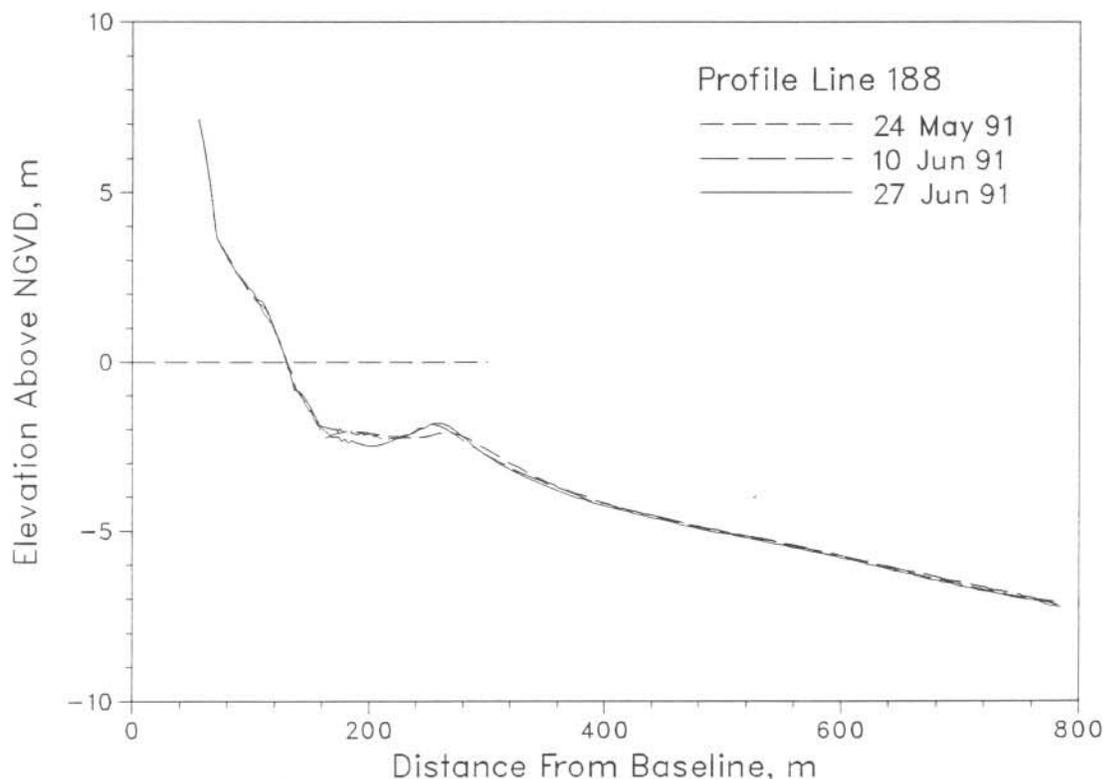


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1991.

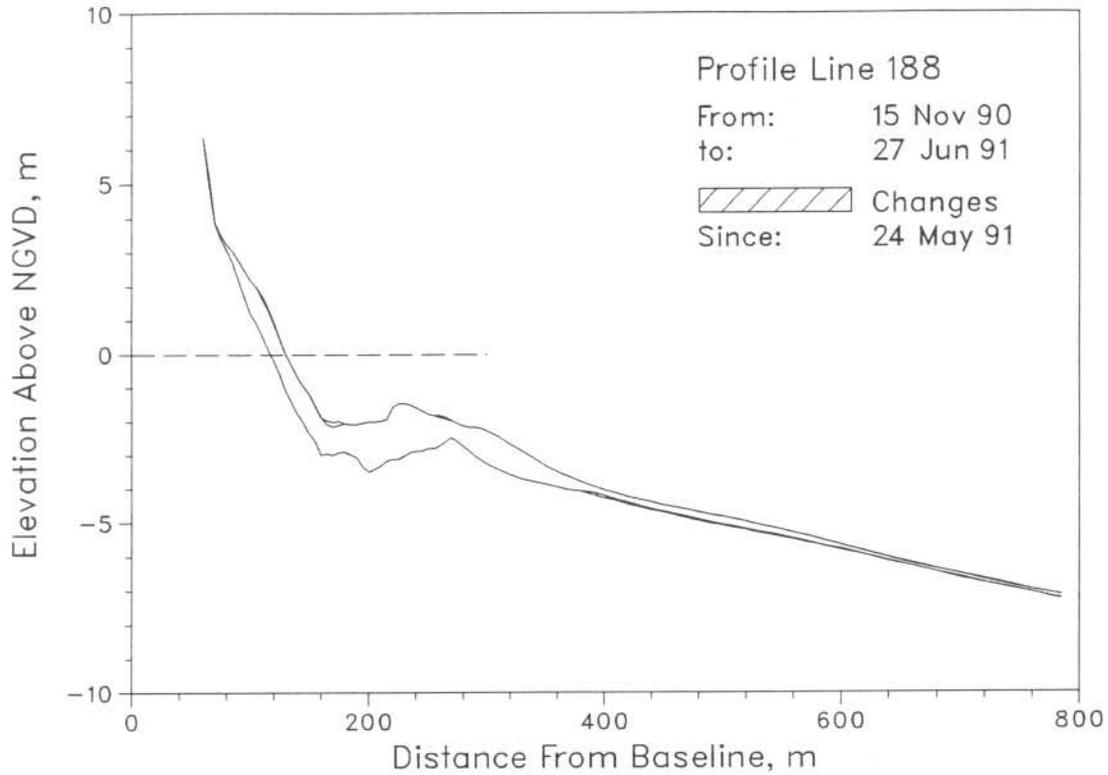


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 27 June. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

PART VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the significant wave height at the seaward end of the pier (i.e. as measured near the end of the pier) exceeded 2 m and four contiguous 34 minute wave records were obtained every three hours:

<u>Start</u>	<u>End</u>
23 Jun (1708)	23 Jun (2342)

B. Storm Synopsis.

23 June - Development of a weak coastal storm off the North Carolina coast early on 22 June produced a short period of storm waves. The maximum H_{mo} (at gage 625) of 2.43 m ($T_p = 8.26$ sec) was attained at 2042 EST on 23 June. This coincided with the maximum winds (from north-northeast) which exceeded 14 m/s occurring at 2008 EST. The minimum atmospheric pressure of 1006.3 mb was recorded on 22 June at 1900 EST. Total precipitation was 25 mm.

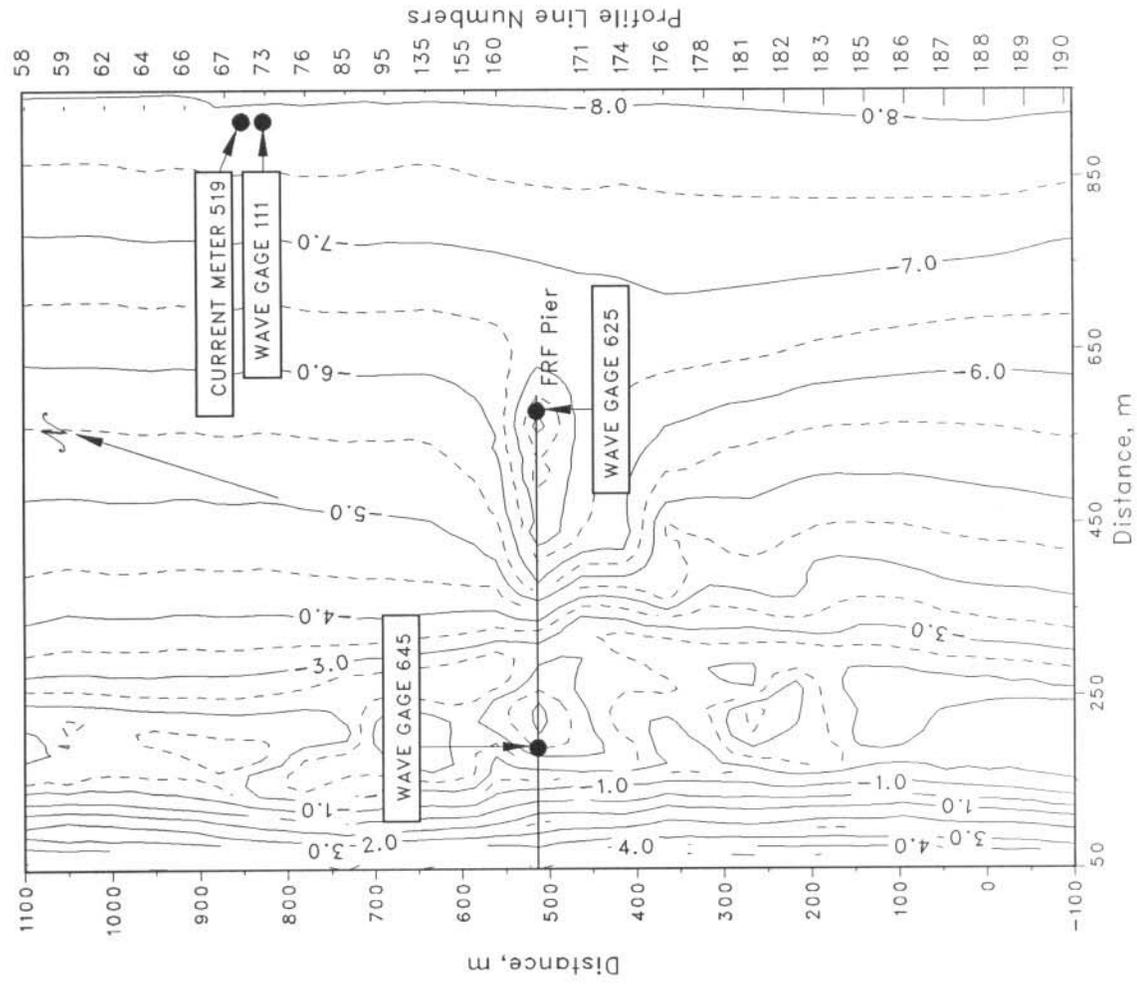
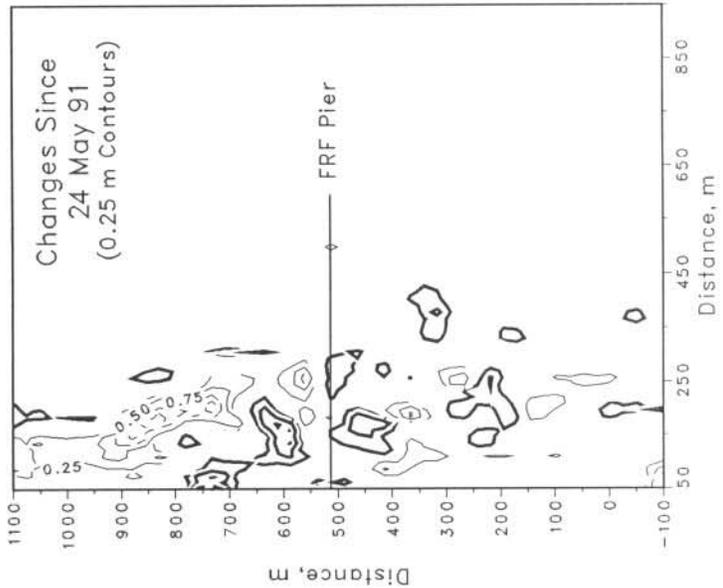
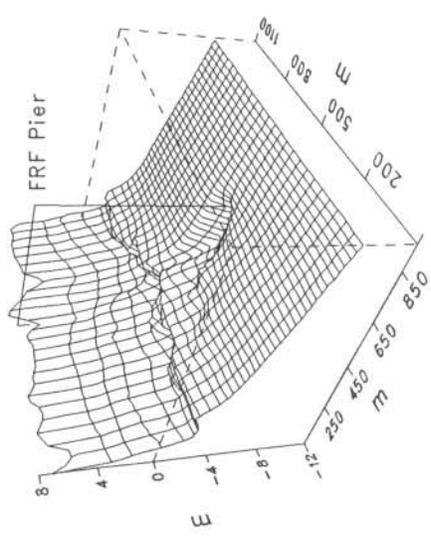


Figure 8. FRF bathymetry 27 Jun 91 depths relative to NGVD

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